



98-30-03  
**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

AF/2815/14

Applicant(s): Vaartstra et al.

Group Art Unit: 2815

Serial No.: 09/603,132

Examiner: Eugene Lee

Filed: June 23, 2000

Docket No.: 150.00650102

Confirmation No.: 3538

Title: DEVICE STRUCTURE INCLUDING RUTHENIUM SILICIDE DIFFUSION BARRIER LAYERS

Assistant Commissioner for Patents  
Mail Stop Appeal Brief- Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

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We are transmitting the following documents along with this Transmittal Sheet (which is submitted in triplicate):

- ☒ An itemized return postcard.  
☐ A Petition for Extension of Time for \_\_\_ month(s) and a check in the amount of \$\_\_\_ for the required fee.  
☒ Please charge deposit account no. 13-4895 in the amount of \$280.00 for Request for Oral Hearing.  
☒ Request for Oral Hearing under 37 C.F.R. § 1.194(b) (1 pg.)  
☒ Reply Brief under 37 C.F.R. § 1.193(b)(1) (5 pgs. - in triplicate).  
Amendment No Additional fee is required. The fee has been calculated as shown:

Fee Calculation for Claims Pending After Amendment					
	Pending Claims after Amendment (1)	Claims Paid for Earlier (2)	Number of Additional Claims (1-2)	Cost per Additional Claim	Additional Fees Required
Total Claims				x \$18 =	
Independent Claims				x \$84 =	
One or More New Multiple Dependent Claims Presented? If Yes, Add \$280 Here →					
Total Additional Claim Fees Required					

Please consider this a PETITION FOR EXTENSION OF TIME for a sufficient number of months to enter these papers and please charge any additional fees or credit overpayment to Deposit Account No. 13-4895. Triplicate copies of this sheet are enclosed.

MUETING, RAASCH & GEBHARDT, P.A.

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**CERTIFICATE UNDER 37 CFR §1.10:**

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Date of Deposit: September 29, 2003

I hereby certify that the Transmittal Letter and the paper(s) and/or fee(s), as described hereinabove, are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR §1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Mail Stop Appeal Brief-Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

By:

Name: SARA E. OLSON

(LARGE ENTITY TRANSMITTAL UNDER RULE 1.10)



#28  
Reg. for Oral Hearing  
Y. Robinson  
PATENT  
Docket No. 150.00650102  
10/9/03

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appellant(s): Vaartstra et al. )  
Serial No.: 09/603,132 )  
Confirmation No.: 3538 )  
Filed: June 23, 2000 )  
For: DEVICE STRUCTURE INCLUDING RUTHENIUM SILICIDE DIFFUSION  
BARRIER LAYERS )

Group Art Unit: 2815  
Examiner: Eugene Lee

REQUEST FOR ORAL HEARING (37 C.F.R. §1.194(b))

Assistant Commissioner for Patents  
Mail Stop - Appeal Brief Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

Appellants hereby request an oral hearing of the Appeal in the above-identified application. The Examiner's answer was mailed on July 29, 2003 and the term for filing the request is two months from that mailing date.

Please charge Deposit Account No. 13-4895 in the amount of \$280.00 to cover the cost of the oral hearing. Please charge any additional fees or credit any over-payment to PTO Deposit Account No. 13-4895.

CERTIFICATE UNDER 37 C.F.R. 1.10:

The undersigned hereby certifies that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR §1.10 on the date indicated below and is addressed to the Assistant Commissioner for Patents, Mail Stop Appeal Brief- Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

*Sara E. Olson*  
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Date

29 Sept. 2003

Respectfully submitted for  
Vaartstra et al.

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#21  
Reply Brief  
4/Robinson  
10/9/03

PATENT  
Docket No.150.00650102

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appellant(s): Vaartstra et al. ) Group Art Unit: 2815  
Serial No.: 09/603,132 ) Examiner: Eugene Lee  
Confirmation No.: 3538 )  
Filed: June 23, 2000 )  
For: DEVICE STRUCTURE INCLUDING RUTHENIUM SILICIDE DIFFUSION  
BARRIER LAYERS

**REPLY BRIEF UNDER 37 C.F.R. § 1.193(b)(1)**

Assistant Commissioner for Patents  
**Mail Stop Appeal Brief-Patents**  
P.O. Box 1450  
Alexandria, VA 22313-1450

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Dear Sir:

Appellants present this Reply Brief both in response to the Examiner's Answer dated July 29, 2003, and in support of the appeal from the final rejection of claims 27-44 in the above-identified application. In addition to generally traversing the arguments of the Examiner's Answer, Appellants provide the following remarks:

**Response to Examiner's Arguments**

**"Chemical Vapor Deposited" as Structural Limitation**

The Office reiterates its characterization of the recitation "chemically vapor deposited" and "chemically vapor codeposited" as product-by-process limitations. Appellants traverse this characterization and respectfully request reversal by the Board for the reasons enumerated in the Appeal Brief and further in view of the remarks provided below.

Contrary to the assertions of the Examiner's Answer, the "gist" of Appellants' argument is not based on the method used to form a diffusion barrier of  $\text{RuSi}_x$  in a semiconductor device. Rather, Appellants submit that the phrase "chemically vapor codeposited" and "chemically vapor deposited" are structural limitations of the claimed apparatus rather than process limitations and,

as a result, must be evaluated like any other limitation found in the claims (*see, e.g., Hazani v. U.S. Int'l Trade Comm.*, 44 U.S.P.Q.2d 1358, 1363 (Fed. Cir. 2000), holding that the limitation "chemically engraved" is not a product-by-process limitation).

For example, as asserted in Appellants' "Declaration Under 37 C.F.R. § 1.132" (filed on January 27, 2003, hereinafter "Declaration"), chemical vapor deposition is an objective feature observable by inspection of the device structure (*see, e.g.,* paragraph 10: "if a chemical vapor deposited diffusion barrier layer and a sputter coated diffusion barrier layer were analyzed by one skilled in the art these structural differences . . . would allow one . . . to identify the diffusion barrier layer as either being a sputter coated diffusion barrier layer or a diffusion barrier layer having been deposited by a different technique (e.g., chemical vapor deposited diffusion barrier layer)"). Thus, the phrases "chemical vapor deposited" and "chemical vapor codeposited" are themselves structural limitations that must be evaluated during examination of the claims.

Nonetheless, the Examiner's Answer asserts that the Declaration does not provide "scientific evidence to support the statements in the Declaration" (*Examiner's Answer*, page 6). Appellants submit, however, that the Declaration is expert testimony regarding the level of ordinary skill in the art and thus must be considered as such by the Office. Accordingly, it is requested that the Board reopen prosecution so that the probative value of the statements in the Declaration regarding various characteristics of chemical vapor deposited layers as compared to sputtered layers, e.g., different structure, lower pinhole counts, reduced surface damage, etc., may be considered.

#### Examination of Claims 39-44

With respect to Appellants' remarks provided both in the Appeal Brief and the Declaration regarding the inclusion of openings in the substrate and various features of those openings, e.g., aspect ratios and layer structures, the Examiner's Answer asserts that Appellants' claims "do not state high aspect ratio structures or deep contacts such that a different structure from chemical vapor deposition could possibly occur," (*see Examiner's Answer*, page 7). Appellants strenuously disagree.

Appellants call the Board's attention to claims 39-44, which were added in the Amendment and Response dated November 14, 2001. These claims clearly address the openings and associated aspect ratios and layer structures. Yet, as indicated by the statements in the Examiner's Answer and by the prosecution history, the Examiner has not considered the particular subject matter of these claims during prosecution. That is, contrary to the assertions found in the Examiner's Answer, the structure of a chemical vapor deposited layer on a surface defining an opening of a substrate is clearly distinguishable over the structure of a sputtered layer on the surface defining the opening (see Declaration). However, the Examiner has not even acknowledged the existence of claims reciting these features. Appellants submit that these claims are clearly not anticipated by Kuroiwa et al. As a result, review and reversal of the rejection of these claims by the Board are respectfully requested.

Other Remarks

Appellants have noted other characteristics in the Appeal Brief to further distinguish the structural aspects of a chemical vapor deposited diffusion barrier layer from a sputter deposited diffusion barrier layer. For example, Appellants identified potential surface damage to the underlying substrate associated with sputter deposition (*see e.g., Appeal Brief*, page 5). The Examiner's Answer, however, responded by stating that, with respect to Matsubara et al., "[i]t is physically not possible that a metal such as ruthenium that is used to form the lower electrode 3 can implant into the substrate where there is a silicon oxide layer covering the substrate." *Examiner's Answer*, page 8. Appellants submit that such a broad statement is unsupported by the evidence on the record and request that, if the Examiner intends to rely on such information, a proper rejection, including identification of the necessary prior art references, be made.

Appellants further identified that a chemical vapor codeposited layer of  $\text{RuSi}_x$  includes a more uniform distribution of silicon throughout the layer, whereas a silicidated Ruthenium silicide layer exhibits a gradient of silicon content throughout the layer (*see, e.g., Appeal Brief*, page 9). The Examiner's Answer asserts that this is not clearly addressed in the Declaration and is thus merely conjecture on the part of the Appellants. Appellants submit, however, that this

gradient characteristic is a concept that is well recognized by those of skill in the art. Thus, it was not perceived to warrant being addressed in the Declaration.

Moreover, Appellants recite, e.g., in claims 27 and 32, a chemical vapor codeposited diffusion barrier layer of  $\text{RuSi}_x$ , where  $x$  is in the range of about 0.01 to about 10. The Examiner's Answer states that Kuroiwa et al. discloses a RuSi layer. As Appellants stated in the Appeal Brief, however, the layer of Kuroiwa et al. is not a *chemical vapor deposited* layer of  $\text{RuSi}_x$  as claimed. Rather, Kuroiwa et al. teaches forming an Ru layer *and then* siliciding the layer to form Ruthenium silicide.

The Appeal Brief further asserted that certain claims, e.g., claims 39 and 41, recite that the surface of the substrate assembly defines an opening, where the chemical vapor deposited diffusion barrier layer is on the surface defining the opening. The Examiner's Answer asserts that Kuroiwa et al. teaches such a layer 132 in Figure 8. However, Appellants note that the layer 132 is clearly not on the surface defining the opening as recited by claims 39 and 41. Rather, the metal silicide layer 132 is formed during heat treatment by a portion of the metal electrode 130 located over the silicon plug 111 (*see, e.g., col. 13, lines 7-29*). As a result, Kuroiwa et al. fails to teach all the elements of claims 39 and 41.

**Reply Brief under 37 C.F.R. § 1.193(b)(1)**

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**Summary**


It is submitted that pending claims 27-44 are patentable in view of the identified art.  
Review and reversal of the rejection are respectfully requested.

Respectfully submitted for  
**Vaartstra et al.**

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29 September 2003

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